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MEN AND MACHINES

MACHINERY has for many years past occupied a dominant role in human activity, but the nature of the relationship between man and machine has begun to receive serious attention only very recently. It required the stress of World War II to focus attention on the need to fit the equipment to suit the natural characteristics of the average man, because it was discovered that modern weapons and instruments, despite their superior engineering perfection, were not delivering their best on account of the human operator, who remained an essential link in all tasks and procedures. As a result, the problems are beginning to attract the attention of scientists from a wide range of disciplines—anatomists, physiologists, psychologists, engineers, physicists and architects—not to speak also of those who are commercially interested in better production and management.

The series of papers presented at a symposium on HUMAN ENGINEERING under the auspices of the New York Academy of Sciences* gives one an idea of what has been achieved in this field, while also indicating the possibilities of such studies in future. In the words of Prof. Leonard C. Mead, "Human Engineering is that endeavour which seeks to match human beings with modern machines so that their combined output will be comfortable, safe and more efficient".

The first requirement for this is the acquisition of knowledge which will specify what the normal working man can do *naturally*. It is proposed that this objective can be satisfied by the collection and dissemination of already existent facts, and by the conduct of further research on the working environment, equipment display, machine controls, and system studies. Such information is to be found in the stockpile of knowledge possessed by the engineering profession and by the biological scientists. But, without co-operative effort on the part of these groups, the solution to many present-day problems may only remain one-sided or unsatisfactory. In addition to what may be accomplished by way of modifying equipment, machines, vehicles, and even prosthetic devices in terms of human characteristics, the possibility is also envisaged of modifying the individual in terms of train-

* *Annals of New York Academy of Sciences*, January 31, 1951.

ing procedures, so as to enable him to fit into his working environments.

Quite similar are the aims and objectives of the ERGONOMICS Research Society, a meeting of which held in April 1951, at Birmingham, was an international event. In his Presidential Address to the Society, Sir Ben Lockspieser observed: "The machines of the engineer are becoming more and more complicated, with a corresponding tendency to become more difficult to control. We can no longer afford to leave the human operator to get along as best as he can. The importance of the study of questions such as these is fully realised by the Ergonomics Research Society and is the main reason for its existence."

It would appear that the engineer in the past has tended to rely too much on measures of engineering efficiency expressed as a ratio of work output to input. This has led to too exclusive an attention being paid to the reduction of the physical effort necessary by the operative; also it was too readily believed that any equipment which reduces the physical effort of the operative inevitably increases output and reduces fatigue. But in these matters of human activity at work, regard must be had to the *whole* man, and particularly to the integrated action of his sensorimotor system. The reduction of load placed on the motor system (that is, the reduction of muscular effort) has very often involved an *increase* in the load imposed on the sensory side. The operative is required to pay increasing attention to dials, indicators and controls, to an extent that is liable to overload the sensory side of the nervous system or call for excessively intricate co-ordination of sensory and motor functions. Such a state of affairs, quite as much as sheer muscular effort, induces what is commonly called fatigue—a condition of which there is little scientific understanding—but which must clearly involve both psychological and physiological components.

Clearly enough, Ergonomics has a great part to play in influencing machine design, so as to secure greater ease and comfort for the man at work, while at the same time contributing to higher industrial efficiency through a more complete satisfaction of the needs of his ego.

A reference must be made in this connection to the subject of *Cybernetics*, a term coined by Dr. Wiener and his collaborators to the study of the transmission of signals in a communication system, both in machines and in living organisms. There is a significant parallel between the elements in the functioning of automatic machines and the human nervous system, and the study of cybernetics, it is claimed, is likely to have fruitful applications in many fields, from the design of control mechanisms for artificial limbs to the almost complete mechanisation of industry.

Such studies as the above will no doubt go a long way in reducing to the minimum the drudgery and the fatigue involved in the working of machines. However, it is not improbable that, despite the utmost that can be done in devising the ideal environmental condition for operational work, there would always be behaviour situations which may outrun our ability to handle them.

INTERNATIONAL CONGRESS OF SERICULTURE

THE International Congress of Sericulture is scheduled to be held in the autumn, 1952. Provisionally Kyoto, Japan, has been suggested as a possible venue for the session, and so far no final decision has been taken in this matter.

The Seminar on Silk, which was held on Nandi Hills, considered the advisability of inviting the Congress to hold the 1952 session in India. The event will serve to establish international contacts among our workers on sericulture, facilitate personal discussion and in general, galvanise the progress of Sericultural Research and Industry in all their sectors.

The Seminar recommended that the Government of India should be approached with a request that it may take such immediate steps as may be deemed necessary, and extend an invitation to the executive of the Congress in Paris.

M. S.

ZOOGEOGRAPHY*

ZOOGEOGRAPHY is a discipline of Zoological Science which requires for its study a thorough knowledge of animal systematics and behaviour; animal ecology; geography, both past and present; climatology, both past and present; palæontology and geology. It is, in fact, an endeavour and not a science in its strict sense, for, however advanced our knowledge of zoogeography may be of any particular region, a considerable amount of speculation must continue to exist in zoogeographical treatises. Prof. L. F. de Beaufort, formerly Director of the Zoological Museum and Professor of Zoogeography at Amsterdam, has done a great service to zoology by embodying his vast knowledge and experience of zoogeographical studies in a readable text-book on the subject. So far, mammals and birds have received the greatest attention in animal geography and though sometimes other terrestrial groups of animals also received attention, inland aquatic faunas had been practically ignored. Prof. de Beaufort's book, even in its title, now lays an emphasis on inland waters which is a welcome departure from earlier works and gives a proper perspective to the subject.

In a short preface, the author thus defines the scope of the work: "Zoogeography of the land and of inland waters as discussed in this book, is principally historic zoogeography, that is to say that the factors influencing present land and freshwater distribution have mostly been effective in the past. But, as in all sciences built on history, such as palæogeography and phylogeny, much is hypothesis, and ever since its infancy historic zoogeography has been looked upon with misgiving by many zoologists. The fault lies with those zoogeographers who have been too rash in building land bridges over oceans or sinking whole continents into the depths of the sea without giving thought to the geological possibilities of such catastrophes."

The greatest fascination of zoogeography lies in an endeavour "to explain the present from the past, or, *vice versa*, to reconstruct the past from the present". Though it may seem simple, it is a very painstaking task. For instance, even the present distribution of a species depends on (*i*) the age of the species, the older the species the greater is likely to be the range of its distribution, (*ii*) the possibilities of its dispersal depending on ecological factors, both biological and physical and (*iii*) the possibilities of its dispersal in the past depending on palæoclimates and palæogeographical features of the country. It is very rightly stated by the author that to build the future edifice of zoogeographical science, one should look to genera or species specialists, for only they can provide the reliable data of distribution through a correct appreciation of speciation.

The author has made it clear and the fact is worth remembering by all zoogeographers that the dispersal of land and freshwater animals are governed by different factors, for many land animals will be able to use a narrow ridge rising out of the sea for crossing from one island to another whereas the same will not be possible in the case of freshwater animals, which will have to wait till the river systems of the two islands become connected.

"Progress in the dispersal of the freshwater fauna will thus be slower than that of land animals, and this difference in time may sometimes help us to form an opinion about the age of the connection."

There is an unlimited wealth of information for zoologists of the different parts of the world in the various chapters dealing with the Holarctic Region, the British Isles, the Oriental Region, the Ethiopian Region, Madagascar and the neighbouring islands, Neogaea, Notogaea and the Celebes, the Moluccas, and the Lesser Sunda Islands. All groups of animals have been given due attention and for the specialist it provides a very useful review of the knowledge upto 1947 or thereabouts.

The utility of this work would have been greatly increased if the author had paid some attention to the rate of speciation in various groups of animals under different ecological conditions. For instance, the author refers to the Malayan element in the fauna of Peninsular India and explains the discontinuous distribution of this fauna on the formation of the Deccan traps in the intervening areas. Taking the isolated fauna as a whole, it can safely be said that in the main the terrestrial isolates migrated during the pluvial periods of the Pleistocene and that the aquatic fauna may have been migrating during the Miocene and Pliocene also. The very highly specialised forms seem to have evolved and spread not earlier than the Pliocene. The formation of the Deccan traps, on the other hand, is stated to have commenced

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* *Zoogeography of the Land and Inland Waters*, by Beaufort, L. F. de. (Text-Books of Animal Biology Series). Pp. viii × 208. Text-Figs. 10. (Messrs. Sidgwick and Jackson Limited, London), 1951, Price 30*sh.* net.

in the late Cretaceous and ended in the early Eocene.

Thus there can be no effect of the latter on the distribution of Malayan element in the fauna of Peninsular India. The Symposium on the Satpura Hypothesis, organised by the National Institute of Sciences of India, seems to have escaped the attention of the author. More data have recently been obtained in favour of the Satpura Hypothesis. The palæontological evidence with regard to the age of the genus *Thynnichthys* Bleeker as Eocene would seem to require a thorough checking.

It must be an oversight on the part of the author to state on page 36 that the "Cobitidæ are restricted to Europe and Asia" when he includes *Nemachilus* among the African fauna on page 103. The work is so closely packed with diversified material that such mistakes are likely to go undetected.

A useful bibliography of 132 references is included at the end of the work and there is a detailed index of 16 pages. The book is of a handy size, beautifully printed and got up. The Editor of the series, Prof. H. Munro Fox, the author and the publishers are to be congratulated on bringing out such a meritorious work of reference.

S. L. HORA.

INDIAN VETERINARY RESEARCH INSTITUTE—DIAMOND JUBILEE

THE Diamond Jubilee Celebration of the Indian Veterinary Research Institute, which was held on 11th March 1951, marks the culmination of 60 years of its useful service to the country. Inaugurating the function, the Hon'ble Shri. K. M. Munshi, Minister for Food and Agri-country. Inaugurating the function, the Hon'ble

"India has one of the most important live-stock industries of the world whose actual as well as potential value is considerable. She possesses 175 million cattle and buffaloes amounting to a quarter of the world's bovine population, in addition to millions of sheep, goats, poultry and other animals. Yet, the *per capita* production and consumption of milk in the country is, perhaps, the lowest in the world. It is said that this is due to adverse environmental conditions. We might therefore look to the I.V.R.I. and the Animal Husbandry Wing for improving these conditions so that the country can make full use of its livestock population. Effort in one direction alone will not be sufficient; what is required is a multi-pronged attack on the complicated problems. Breeding, proper management, feeding of live-stock and disease control must be tackled in one comprehensive scheme which can no doubt be linked with the Grow More Food Campaign ultimately."

LADY TATA MEMORIAL TRUST
SCHOLARSHIPS AND GRANTS FOR THE YEAR 1951-52

THE Trustees of the Lady Tata Memorial Trust announce on the death anniversary of Lady Meherbai Dorabji Tata, 18th June 1951, the awards of Scholarships and Grants for the year 1951-52.

The International Awards of varying amounts (totalling £3,600) for research in diseases of the blood with special reference to Leucaemias are made to Doctors Pascou Atanasiu (France), J. Bichel (Denmark), George Discombe (England), Astrid Fagraeus and Bo. Thorell (jointly) (Sweden), Henri P. L. Febvre (France), Niels M. G. Harboe (Denmark), Charles Oberling (France), Gunther Schallock (Germany), J. B. G. Dausset (France), C. C. Ungley (England), and A. R. Gopal-Ayengar (India).

Indian Scholarships of Rs. 250 per month each for one year for scientific investigations having a bearing on the alleviation of human suffering from disease are awarded to Messrs. Samavedam Srinivasa Sriramacharyulu (Andhra), Gangagobinda Bhattacharya (Calcutta), Madhav Vinayak Patvardhan (Coonoor), Anant Vithal Sunthankar (Bombay), and Dr. (Miss) Smitha Popatlal Bharani (Bombay) and Miss Kamala Ramaswamy (Bombay).

SEMINAR ON SILK

FOR the first time in the history of Sericulture in India, a Seminar on Silk covering every aspect of the industry, was organised by Janab Shamsuddin Khan, the energetic Director of Sericulture in Mysore, under the inspiring and enlightened patronage of the Government of Mysore, who have taken a keen and active interest in the development of the industry in the State. The Seminar was held in the serene and picturesque environs of the Nandi Hills and lasted for five days (14th to 18th June). Delegates from the neighbouring silk-producing States, Madras and Bombay, representing Sericulture and Industry, participated in the proceedings of the Seminar. An instructive exhibition which was organised specially for the Seminar, served to highlight and pinpoint in a vivid and striking manner the pressing problems of the Silk Industry awaiting solution.

It is particularly appropriate that the first Seminar on Silk should be held in the State of Mysore which is responsible for 60-70 per cent. of the India's production of silk. Her silk is distinguished for its higher tensile strength, superior lustre and durability. During World War II, Mysore Silk, on account of its tensile strength, was chosen for the manufacture of parachute fabrics. There has been a harmonious and balanced development of the industry in all its sectors in Mysore. Mysore has led the rest of India in the development of sericulture. The pre-eminent position which Mysore holds to-day in the field of silk, is largely due to the pioneering work carried out by *Rajasevaprasakta* Sri. Navaratna Rama Rao, Retired Director of Industries and Commerce and Vice-Chairman of the Central Silk Board, who may be considered the Patriarch of the Modern Silk Industry in India. It has been a matter of great satisfaction that the Director of the Seminar, Janab Shamsuddin Khan, was able to secure the inspiring presence of Sri. N. Rama Rao during the Seminar and induce him to guide the deliberations of one of the important groups.

The discussions of the Seminar were held under five groups:—*Group I: Moriculture*—Sericulture and Seed Supply under the Chairmanship of Sri. N. Rama Rao; *Group II: Silk Reeling—Charka and Filatures*—Silk Conditioning and Testing, Spun Silk Manufacture and Utilisation of Bye-Products, under the Chairmanship of Sri. M. A. Srinivasan; *Group III: Silk Throwing (Handloom and Powerloom)*—Dyeing, De-Gumming and Silk Weaving, under the guidance of Sri. P. Subbarama Chetty; *Group IV: Research and Education*, under the Chairmanship of Prof. M. S. Thacker; and *Group V: Finance, Marketing and Co-operation*, under the guidance of *Rajamantrapravina* Sri. A. V. Ramanathan.

The Indian Silk Industry is, in many respects, comparable to that of Lac. Both occupy a vital position in the agricultural and rural economy of our country. Both have been affected by the uncertainty of crops, the consequent violent fluctuations in the market and in recent years, competition from synthetic substitutes. These vicissitudes have been responsible for the economic instability which characterises these two of her important industries. In the case of silk, Japan has, for years, been our successful competitor. Price of Japanese silk imported into India is only half the cost at which our silk could be sold in our markets. Japanese silk, in some respects, is of a superior quality.

To-day, India produces only a quarter of her requirements; to attain a state of peace-time self-sufficiency, it has been estimated that the country will have to produce ten million pounds of silk valued at 30 crores of rupees. An industry of this economic magnitude and vital importance, is naturally entitled to the active and sympathetic support of the Government, if it should attain the same state of economic efficiency and technological supremacy which characterise the Japanese silk industry to-day.

In the course of the discussions held in the several groups of the Seminar, there has been an encouraging unanimity of opinion, that the remedy to the longstanding and almost chronic disabilities of the industry, lies in planned scientific research, both fundamental and applied. Sri. Navarathna Rama Rao declared that for improving and stabilising the silk industry, India must produce the necessary knowledge in her own laboratories, and added that it offends our self-respect as a free nation to be conscious that we have to depend upon other nations for such knowledge. So far as the interests of Lac are concerned, the Indian Lac Research Institute which was started in 1930, has been trying to create new knowledge which has gone a long way in stabilising this industry. Other commodities like cotton, cocoanut, coffee, tea, etc., are having their own laboratories. Silk, it is hoped, will soon have a Central Research Institute, whose early creation will help to solve the many fascinating and urgent problems and thereby establish a stable and prosperous silk industry in India.

M. S.

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THE MAGNETO-OPTIC CONSTANTS OF SODIUM BROMIDE

The Faraday rotation in a single crystal of sodium bromide of 1·30 mm. thickness has been measured for the first time using a magnetic field of 15,400 Oersteds. The magneto-optic constants have been evaluated using the dispersion data available in Landolt and Bornstein Tables. The Verdet constant V has the values 0·0621 and 0·123 minutes per cm. per Oersted for the wavelengths λ 5461 and λ 4358, while the corresponding values of the magneto-optic anomaly γ are 0·86 and 0·88 respectively. The estimated accuracy is about 2 per cent. It is interesting to note that for sodium chloride V_{5461} is 0·0410 and γ is 0·91.

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FARADAY EFFECT AND BIREFRINGENCE

When plane polarised light is incident on a birefringent crystal placed in a magnetic field with the electric vector parallel to one of the principal planes of vibration of the crystal, the emergent light is, in general, elliptically polarised. The major axis of the emergent ellipse is inclined at an angle ψ to the plane of vibration of the incident light, which is given by the equation,[1]

$$\tan 2\psi = \frac{\sin 2\gamma \sin \Delta}{\cos^2 2\gamma + \sin^2 2\gamma \cos \Delta},$$

where

$\Delta = \Delta_0 t = t\sqrt{\delta_0^2 + (2\rho_0)^2}$ and $\tan 2\gamma = 2\rho_0/\delta_0$. Δ_0 is the relative phase retardation per unit length, δ_0 the phase retardation when there is no magnetic field, ρ the rotation per unit length when there is no birefringence and t is the thickness of the specimen.

It can be shown by suitable algebraic manipulation that, when δ_0 is small, $2\psi = 2\rho\ (1 - \delta^2/3!)$, where $\rho = \rho_0 t$ and $\delta = \delta_0 t$; and when $2\rho/\delta$ is small, $\tan 2\psi = (2\rho \sin \Delta)/\delta$. As it is easy to measure ψ and ρ with the aid of a half shade, these formulæ would prove extremely useful in the determination of the photoelastic constants of isotropic solids. One measures ρ the rotation for a particular value of the magnetic field when the solid is not strained, and again ψ the rotation with the same field and a known applied stress. Then δ can be easily evaluated from the last two equations. As 2ρ is, in general, small, the two equations cover the range of values of δ usually met with.

The authors' thanks are due to Prof. R. S. Krishnan for the kind interest he showed in this investigation.

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Ind. Inst. of Science, V. CHANDRASEKHARAN.
Bangalore,
May 20, 1951.

1. Pockels, *Lehrbuch der Krystall-optik*, 1906.

UNIT CELL AND SPACE GROUP OF BARIUM CHLORATE MONOHYDRATE

FROM a saturated aqueous solution, barium chlorate crystallises at room temperature in the form of needles with one molecule of water of crystallisation. Morphological studies[1] show the crystal class to be C_{2h} with the c-axis as the needle axis.

Rotation and oscillation photographs about the three axes gave the following values for the unit cell dimensions:—

$a = 8{\cdot}9$ A, $b = 7{\cdot}8$ A, $c = 9{\cdot}3$ A.

More accurate values of cell dimensions calculated from high order reflections $h00$, $0k0$ and $00l$ in Weissenberg photographs are

$a = 8{\cdot}86 \pm {\cdot}02$ A $b = 7{\cdot}80 \pm {\cdot}02$ A
$c = 9{\cdot}35 \pm {\cdot}02$ A $\beta = 94° \pm ½°$

giving the axial ratio $a : b : c = 1{\cdot}14 : 1 : 1{\cdot}20$. These values for $a : b : c$ and for the angle β agree well with the values got from morphological studies, which are $a : b : c = 1{\cdot}142 : 1 : 1{\cdot}198$ and $\beta = 93° 34'$. The fact that the intensities of the reflections hkl and $h\bar{k}l$ are equal confirm the result of the morphological studies that the symmetry is monoclinic. Taking the density to be 3·18,[2] the number of molecules per unit cell comes out to be 3·84 which is very nearly four.

Zero level and first level equi-inclination Weissenberg photographs about the c-axis revealed the following extinctions: $hk0$ is absent if $h + k$ is odd and hkl is absent if $h + k + l$ is odd respectively. The first set of extinctions is only a special case of the second when l is zero. This result indicates that the above unit cell is body centred.

Zero level Weissenberg photographs about the b-axis showed that $h0l$ reflection is absent if either h or l is odd. This indicates the presence of a (010) glide plane with glide component $a/2$ or $c/2$. The a-glide and the c-glide are equivalent because of the body centering.

Thus the only possible space group for barium chlorate monohydrate is $I\,2/c$ ($I\,2/a$, $I\,2_1/a$, $I\,2_1/c$). The b-axis of the unit cell is either a screw axis or a rotation axis depending on the choice of origin; and the direction of glide depends on the position of the glide plane.

By choosing a different set of axes a', b', c' given by the transformation,[3]

$$\begin{vmatrix} a' \\ b' \\ c' \end{vmatrix} = \begin{vmatrix} 1 & 0 & 1 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{vmatrix} \begin{vmatrix} a \\ b \\ c \end{vmatrix}$$

we can change the body centered lattice to a c-face centered lattice, which transforms the space group into $C\,2/c$, the standard form given in the International Tables. In this case, the cell constants are $a' = 13{\cdot}27$ A, $b' = b = 7{\cdot}80$ A, $c' = c = 9{\cdot}35$ A, $\beta = 41° 46'$. The new unit cell has the same volume as the body centered one and hence contains four molecules per unit cell.

In conformity with the convention that those axes are to be chosen for which β is nearest to 90°, we prefer the body centered unit cell and assign the crystal to the space group C^6_{2h}—$C2/c$ in the particular configuration $I\,2/c$.

I wish to express my gratitude to Prof. R. S. Krishnan for his kind interest and encouragement and to Dr. G. N. Ramachandran for suggesting the problem and his guidance and help.

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May 21, 1951.

1 Groth, P., *Chemische Krystallographie* **2**, 114. 2. *Handbook of Physics and Chemistry*, 30th Edn., 1948. 3. Buerger, M. J., *X-ray Crystallography*, John Wiley, 1942.

THE AMINO-ACIDS AND AMIDES OF FRESH AND WITHERED TEA-LEAF

DURING withering of tea leaves, the first process in the manufacture of black tea, marked

chemical changes take place, including an appreciable protein breakdown and a corresponding increase in the water-soluble nitrogen. These changes are clearly shown by paper chromatography.

Whatman No. 1 Sheets, 22" × 18", have been used, employing the descending technique. Full details of apparatus and solvents have been previously described (Roberts and Wood).[1] Amino-acids are detected by spraying with ninhydrin (0·1% in *n*-butanol).

The diagram below gives the pattern of spots obtained with expressed juice from withered leaf. The identifications were made in the first place by reference to published R_f values and maps for pure amino-acids when run individually (Consden, Gordon and Martin,[2] Steward and Thompson,[3] Proom and Woiwod,[4] Govindarajan and Sreenivasaya[5]). Confirmation in most cases was obtained by observation of the positions taken up on the chromatogram by added amino-acids. Colour reactions such as those obtained with tyrosine and proline gave further confirmatory evidence, as did the behaviour of amides on hydrolysis.

Owing to the autoxidation, under alkaline conditions, of polyphenols (which are subsequently detected on the same chromatogram) no ammonia could be added in the phenol run, thus affecting separation of the basic amino-acids. Although lysine could be identified, arginine and histidine both travelled to the same position on the chromatogram and have not been identified individually in the juice.

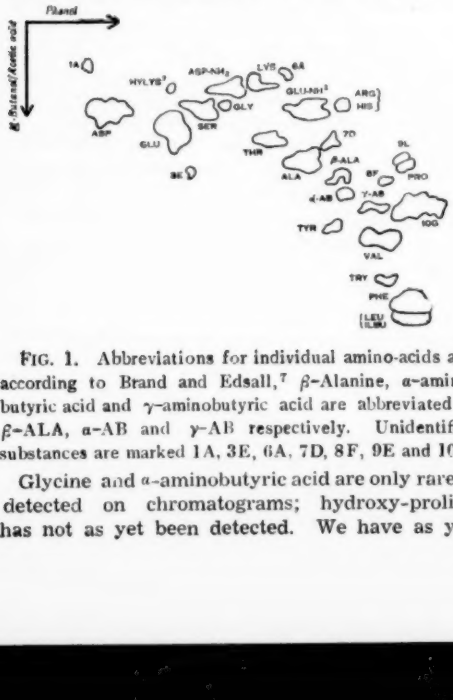

FIG. 1. Abbreviations for individual amino-acids are according to Brand and Edsall,[7] β-Alanine, α-amino, butyric acid and γ-aminobutyric acid are abbreviated to β-ALA, α-AB and γ-AB respectively. Unidentified substances are marked 1A, 3E, 6A, 7D, 8F, 9E and 10G.

Glycine and α-aminobutyric acid are only rarely detected on chromatograms; hydroxy-proline has not as yet been detected. We have as yet no information concerning the sulphur-containing amino-acids, but all other naturally occurring amino-acids are apparently present in tea-leaf juice if a rather tentative identification of hydroxylysine be accepted. It is of interest that β-alanine and γ-amino-butyric acid are probable normal components of both fresh and withered tea-leaf.

The chromatogram shows several unidentified spots which apparently do not correspond with any of the known amino-acids. One of these spots, 10G, is the strongest spot on the chromatogram and corresponds with what Consden and Gordon[6] believed to be a mono-ester of glutamic acid. The nature of this substance is under study at present.

The effect of withering on the contents of free amino-acids and amides of tea-leaf is given in Table I. There is a general increase in all amino-acids and amides as a result of withering, but the unidentified substances in general are unaffected or show a decrease.

TABLE I

Substance reacting with ninhydrin	Intensity of spot	
	Fresh leaf	Withered leaf
1A ..	1	nil
Aspartic acid ..	3	5
3E ..	1	trace
Glutamic acid ..	4	5
Hydroxylysine ? ..	trace	0–1
Serine ..	2	3
Asparagine ..	0–1	3
Lysine ..	1	2
Threonine ..	1	2
6A ..	nil	0–1
Glutamine ..	2	3
Alanine ..	2	3
Arginine and Histidine ..	0–1	0–1
7D ..	1	1
β-Alanine ..	0–1	1
Tyrosine ..	1	2
8F ..	1	0–1
Proline ..	nil	1
9E ..	1–2	1
γ-Aminobutyric acid ..	1–2	2
Valine ..	1	4
Tryptophan ..	0–1	1
Leucines and Phenylalanine ..	1	4
10G ..	10	10

The figures 1 to 10 indicate the relative intensities of the spots.

It will be observed that both in the fresh and withered leaf, aspartic and glutamic acids are the most abundant of the amino-acids occurring.

The table above gives amino-acid contents in shoots consisting of the two terminal leaves and bud. The distribution is not the same in all

parts of the shoot and it has been found that the stem is particularly rich in glutamine and substance 10G and relatively poorer in amino-acids.

Tocklai Experi. Station, Indian Tea Association, Cinnamara, Assam,
E. A. H. Roberts.
D. J. Wood.
April 6, 1951.

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EFFECT OF MILLING ON THE THIAMINE AND PHYTIC ACID CONTENT OF RICE

The F.A.O. Nutrition Committee[1] for South and East Asia recommended at its Baguio meeting in 1948 that a thiamine content of 1·8 micrograms per gram should be regarded as a minimum standard for milled rice. The thiamine content of rice being itself important is also an index of the degree of retention of other nutrients. Production of rice which retains 1·8 γ per gm. of thiamine may contain more of phytic acid phosphorus. The amount of calcium supplied by rice diets falls short of calcium requirements and this calcium deficiency will be enhanced by controlling the degree of milling with an increased imbalance of Ca : P ratio. The rickets-producing and anti-calcifying action of phytates is quite well established.[2]

The phosphorus in rice is present both in the organic form as phytic acid and in the inorganic form. McCance and Widdowson[3] have estimated the phytic acid content of rice before and after milling. Recently Collumbine[4] have studied the mineral metabolism of rice diets with reference to the role of organic and inorganic phosphorus. In the present investigation, the phytic acid content, total phosphorus and the relative thiamine content of samples of rice after different grades of polishing were determined. For the estimation of phytic acid, the method of McCance and Widdowson[3] was followed. Total phosphorus was estimated by King's modification[5] of Fiske and Subbarow's procedure.[6] Thiamine was determined by the method given by Paul Gyorgie.[7]

The results are given in Table I.

Table I

Sample	Degree of polishing	Thiamine (μg./g.)	Phytic acid P (mg./100g.)	Total P (mg./100 g.)	% of Phytic acid, P of total P
I	Unpolished	3·60	324	348	92·9
	4% polished	3·10	180	238	75·6
	7·5% polished	1·80	120	181	66·3
	13·1% polished	1·14	107	124	86·3
II	Unpolished	2·60	224	266	84·1
	6% polished	2·20	161	190	84·8
	12% polished	1·30	70	135	51·8
	18% polished	0·60	66	110	60·9

The percentage loss of thiamine and phosphorus with the degree of milling is given in Table II.

Table II

Sample	Degree of polishing	% Loss of thiamine	% Loss of phytic acid P
I	4%	13·8	49·4
	7·5	50·0	62·96
	13·1%	68·32	67·0
II	6%	15·38	37·1
	12%	50·0	68·7
	17%	76·9	70·70

Table II shows that in the initial stages of milling there is a greater percentage of loss of phytic acid phosphorus than that of thiamine. So it seems to be advisable to have a certain degree of milling to remove part of the phosphorus. With 6 per cent. of polishing there is about 15 per cent. loss of thiamine and 40 per cent. loss of phytic acid P, whereas with about 12 per cent. the thiamine loss is considerable. Full details of the investigation will be published elsewhere.

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Bangalore 3,
February 9, 1951.

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ELECTRO-DEPOSITION OF SILVER-LEAD AND COPPER-ZINC ALLOYS FROM CYANIDE-FREE BATHS

SILVER-LEAD: An alloy of silver with 3 to 5 per cent. lead is an excellent bearing metal that can carry heavy bearing loads and is also useful from the view-point of corrosion-resistance. Very little work has been reported on the electro-deposition of this alloy. Mathers and Johnson[1] and Faust and Thomas[2] have obtained satisfactory deposits from silver cyanide-plumbite and silver cyanide-tartrate baths respectively, but not from cyanide-free baths of the fluosilicate and nitrate-tartrate type.[1]

Rama Char and Sadagopachari[3] have shown that the silver iodide bath for the electro-deposition of silver (on copper) is quite comparable to the cyanide bath used in the electroplating industry. Silver-lead alloys can be electro-deposited on copper from an iodide bath prepared by dissolving silver iodide and lead acetate in potassium iodide, using silver and lead anodes. With a solution of the composition: Ag(g/L)—1 to 10, Pb (g/L)—20, and KI(g/L)—900, c.d.—0·4 amp/dm^2 and temp. —26° C., an alloy of widely varying composition, including the bearing alloy low in lead, is obtained. The deposits are smooth and adherent, being gray, ivory white to silvery bright in appearance. The silver-lead ratio in the alloy ranges from 12 per cent. Ag—88 per cent. Pb to 99·5 per cent. Ag—0·5 per cent. Pb, with a variation from 1 to 10 g/L in the concentration of Ag. The throwing power of the bath is satisfactory.

COPPER-ZINC: The co-deposition of copper and zinc has been discovered as early as 1841 and brass is perhaps the most widely electro-deposited alloy on a commercial scale. In view of the poisonous nature and comparative instability of the cyanide bath used in industrial brass plating, some attempts have been made to electro-deposit the alloy from cyanide-free baths. Chloride-sulphate baths have been described by Brunel, *et al.*[4] and Bennett,[5] sulphate by Jacobs,[6] Thompson[7] (with other additions) and Faust,[8] thiocyanate by Faust,[8] oxalate by Bechard[9] and thiosulphate by Gernes and Montillon.[10] So far there has been little success from the industrial point of view.

In previous communications from this laboratory[11,12] it has been reported that copper salt-ethanolamine baths gives electro-deposits of copper (on steel) which are quite comparable to those obtained from the commercial cyanide bath. The ethanolamines form complexes with zinc salts in aqueous solutions,[13] but unlike the copper complex, a clear zinc salt-triethanolamine solution can be obtained by adding ammonia instead of excess amine. A solution containing 20 g/L zinc sulphate, 60 c.c./L triethanolamine and 55 c.c./L ammonia (24 per cent.) gives satisfactory electro-deposits of zinc on steel in the c.d. range 0·24 to 0·80 amp/dm.^{2} By adding copper sulphate, the resulting copper salt-zinc salt-triethanolamine solution can be used for the co-deposition of copper and zinc on steel, with brass anodes, giving smooth and adherent deposits of brass of widely varying copper-zinc ratio. The throwing power of the solution is satisfactory. The experimental conditions are: copper sulphate—5, 10 and 15 g/L; zinc sulphate, triethanolamine and ammonia—same as for zinc deposition; c.d.—0·6 amp/dm^2, voltage—1·7 to 2·2 volts, pH 9·8 to 10·0, temp. —24° C. and time of deposition—25 mins. The deposit is whitish, yellow to red in appearance and the composition is Cu per cent.—29, 60 and 68, Zn per cent.—71, 40 and 32 respectively at the 3 concentrations of copper sulphate.

Our thanks are due to the Head of the General Chemistry Section for giving facilities and taking interest in the work.

Electrochemistry Lab., Gen. Chem. Section, Indian Inst. of Science, Bangalore 3, *April* 28, 1951.

R. SADAGOPACHARI.
N. B. SHIVARAMAN.
T. L. RAMA CHAR.

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DIFFERENCES IN THE SENSITIVITY OF CHOLERAGENIC STRAINS OF *VIBRIO CHOLERAE* TO THE ACTION OF DIFFERENT ANTICHOLERIC THERAPEUTIC AGENTS

DURING the course of laboratory investigations on the chemotherapy of cholera with indigenous plant material, a significant difference in the relative sensitivity of the Inaba and Ogawa strains of *Vibrio cholerae* was observed. In

fact, with Plant No. 26, whereas there was no growth of Inaba by the deep trench method, the Ogawa strain flourished moderately luxuriantly.

To study any possible antigen-drug relationship, formosulphathiazole and sulphaguanidine, the two sulpha drugs reported to be of value in the treatment of cholera[1-4] were selected and their *in vitro* and *in vivo* action on the two choleragenic strains determined by procedures which have already been reported.[1] In addition, the "mouse fæcal suspension test"[5] was also included in this study.

Whereas *in vitro* 35 mg. of formosulphathiazole was completely vibricidal (complete absence of vibrios in the test mixture after 48 hours incubation at 37° C.) and 25 mg. vibriostatic to the Inaba strain, similar action with the Ogawa strain was manifest at 45 mg. and 30-35 mg. levels respectively. Even in as high a concentration as 700 mg. sulphaguanidine was not vibricidal. Concentrations of this drug ranging from 425-450 mg. and 475-500 mg. were, however, vibriostatic to the Inaba and Ogawa types respectively. These observations indicate the higher susceptibility of the Inaba strain of *Vibrio choleræ* to both types of drug action.

Sets of mice were fed with formosulphathiazole and sulphaguanidine for three consecutive days (dosage: 3 gm. per Kilo per day) and thereafter fæcal samples collected at the end of the first, second, third and fourth day. Serial dilutions in peptone water of the sterilised "fæcal drug suspension" were titrated against inocula of different sizes of the two strains of *Vibro choleræ*. Whereas formosulphathiazole (mouse fæcal) suspensions were completely vibricidal to Inaba type in 1 : 160 dilution, similar action to the Ogawa type was manifested only at 1 : 40 dilution. The vibriostatic action was also more marked with the Inaba type. The antibacterial activity of sulphaguanidine was of a much lower order, with no vibricidal action, again indicating a clear-cut difference in the relative sensitvity of the two strains to the two drugs under examination.

The results of *in vivo* mouse protection tests further confirmed the above observations. Whereas 150 mg. of formosulphathiazole, administered intraperitoneally (dosage schedule: 30 mg. per day), gave 70 per cent. protection with the Inaba type, only 50 per cent. of mice, receiving the same dose of 2 M.L.D. (4,000 million cells) of the Ogawa type, survived. Sulphaguanidine under identical conditions, given in half the above-mentioned doses, failed to protect mice with 2 M.L.D. infection. With 1 M.L.D., however, the relative survival ratio (Inaba to Ogawa) was 70 per cent. to 50 per cent. These observations again bring out the higher resistance of the Ogawa type of cholera vibrio to anticholeric drugs.

Recorded data[6,7] indicate that although during epidemics the Inaba and Ogawa types of *Vibrio choleræ* co-exist, their relative prevalence, nevertheless, varies from place to place and from year to year. Wide variations in the experimental results of clinical investigations on different alleged anticholeric therapeutic agents have been reported from the endemic areas of cholera—the Gangetic delta in the East and that of Cauvery in the South. The studies reported here emphasise the need for bacteriological type interpretation of the available clinical data in therapeutic investigations on cholera.

Calcus Res. Laboratory, S. S. BHATNAGAR.
St. Xavier's College, F. FERNANDES.
Bombay, A. C. MANIAR.
March 22, 1951.

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NITROPHENYL ALKYL SULPHIDES, SULPHOXIDES AND SULPHONES

IN view of the known antibacterial activity of certain sulphones, the synthesis of p-nitrophenyl β–dichloroacetamido–β–hydroxyethylsulphone, a sulphone analogue of chloromycetin, has been undertaken. Some of the compounds prepared during the course of its synthesis exhibit high antibacterial activity against several organisms. The following compounds which have so far been prepared are derivatives of p-nitrothiophenol, but for comparison with the more active series, a few derivatives of o-nitrothiophenol and p-nitrophenol were also prepared:—p-nitrophenyl β-hydroxyethyl sulphoxide, m.p. 124°; p-nitrophenyl β-hydroxyethyl sulphone, m.p. 125°; p-aminophenyl β-hydroxyethyl sulphide, b.p. 190° (bath temp.)/15 mm.; 2 : 6-diiodo-4-nitrophenylthioglycollic acid, m.p. 112° (dec.); p-nitrophenyl carboxymethyl sulphoxide, m.p. 141°; p-nitrophenyl

carboxymethyl sulphone, m.p. 167°; *p*-nitrophenyl carbomethoxymethyl sulphone, m.p. 126°; *p*-nitrophenyl α-bromo-α-carbomethoxymethyl sulphone, m.p. 131°; *p*-nitrophenyl bromomethyl sulphone, m.p. 164°; *p*-nitrophenyl dibromomethyl sulphone, m.p. 170°; *p*-nitrophenyl 2 : 3-dihydroxypropyl sulphide, m.p. 93·5°.

The general method of synthesis of the compounds consists in the reaction of the sodium salts of the appropriate thiophenols and phenols with ethylene chlorhydrin or glycerol-α-monochlorhydrin or with chloracetic acid in alcoholic or aqueous solution. The sulphides were oxidized by treatment with hydrogen peroxide in acetic acid to the corresponding sulphoxides and sulphones. Reduction of the nitro compounds to the corresponding amines was effected in alcoholic solution by hydrogen in presence of Raney nickel. 2 : 6-Diiodo-4-nitrophenylthioglycollic acid was prepared by iodination of *p*-nitrophenylthioglycollic acid with iodine monochloride in acetic acid. Bromination of *p*-nitrophenyl carboxymethyl sulphone under various conditions always gave *p*-nitrophenyl dibromomethyl sulphone, whereas bromination of *p*-nitrophenyl carbomethoxymethyl sulphone yielded the desired *p*-nitrophenyl α-bromo-α-carbomethoxymethyl sulphone. Treatment of the latter compound with aqueous alkali gave *p*-nitrophenyl bromomethyl sulphone by simultaneous hydrolysis and decarboxylation.

The antibacterial activity of these compounds is being reported upon separately by Prof. B. V. Bhide and Mr. P. Y. Dighe.

Dept. of Chem. Tech., Univ. of Bombay, Matunga Road, Bombay 19,
May 4, 1951.

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ULTRA-MICRO PAPYROGRAPHY

PARTITION chromatography (papyrography) with filter paper strips and sheets, first introduced by Consden, *et al.*[1], was carried out by the capillary descent of the solvent. Horne and Pollard[2] and Williams and Kirby[3] brought about a considerable simplification of the technique and apparatus by adopting the capillary ascent of the solvent. The method of Rockland and Dunn[4] represents a micro adaptation of the one-dimensional strip method which also involves capillary ascent. This micro-method was critically studied by Govindarajan and Sreenivasaya[5] and has since been successfully applied to a variety of biochemical problems. Usually spotting is carried out with 2 to 4 μl of the solution which contains about 5 to 15 μg of the substance, as in the case of amino acids and sugars. For a determination of the relative concentration of the various forms of penicillins in a sample of fermented beer, one usually employs 5 units of the antibiotic.[6] A reduction in this quantity was effected by Karnovsky and Johnson[7] who worked with 1-2 units.

In certain types of investigation, *e.g.*, the determination of (1) penicillin-producing capacity of single spores of fungi, (2) penicillin levels in physiological fluids and tissues after injection and (3) allied problems, we were faced with the problem of detecting and estimating smaller quantities of the antibiotic. It was felt that, by using sewing thread of cotton as the cellulosic support in place of the strip of filter-paper, this object of determining the antibiotic in ultra micro quantities might be achieved.

Sewing thread, after successive treatments with (1) benzene, (2) hot water, (3) takadiastase, was washed with water, alcohol and finally with ether. The thread was then impregnated with M/15 phosphate buffer pH 6·2 and air dried. The thread, thus treated (about 400 mm. in length) was used for each experiment. For "ascending" papyrography, the thread (T) (see Fig. 1) was tied to a glass

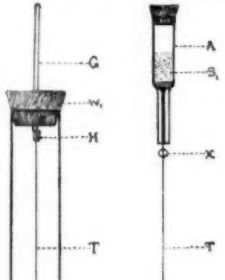

FIG. 1

hook (H) drawn at the end of a glass rod (G) held by a wooden cork (W_1). The other end of the thread is suitably weighted by a glass ring or bead (B) which helps to maintain the thread vertically. The thread is spotted with the test solution at a place (X) about 10 mm.

above the glass ring (B) and air dried. The cork-rod-thread (W_1–G–T) assembly is carefully placed in a chamber (C) consisting of a glass tube (450 mm. × 35 mm.) which is closed at the other end by means of a wooden cork (W_2) which provides a platform for the receptacle (R) containing the developing solvent (S_1) saturated with water. The chamber (C) is lined with filter paper wetted by the solvent-saturated water (S_2) which helps to facilitate rapid equilibration of the system. After a couple of hours during which equilibrium is attained, the thread is carefully lowered into the developing solvent by pushing down the glass rod (G) so that the spotted portion of the thread is well above (at least 5 mm.) the solvent surface. The capillary ascent of the solvent commences immediately and with a solvent like water-saturated ether, the development is usually complete in about an hour. The cork-rod-thread assembly is then carefully lifted out of the chamber, the thread, air dried and bioautographed by the method described earlier,[8] employing a suitable organism. In the case of penicillin we have employed *Strep. aureus* for all the bioautographic tests. The results of one such test is figured in Fig. 2.

The method can be adapted for the "descending" development technique. In place of the glass rod (G), an adapter A (see Fig. 1) made of Pyrex tube (10 × 50 mm.) to which a Pyrex capillary (1·0 mm.) and (50 mm. × 7 mm.) is fused, is employed. The thread is knotted at one end, passed through the capillary and pulled so that the knot plugs capillary. The thread which is thus held in position, is then weighted by a glass ring (B) at the other end. The spotting of the thread with the test solution is carried out at a place a few millimetres (X) below the end of the capillary. A small quantity of treated absorbent cotton is used for reinforcing the plug. The assembly consisting of the adapter and the weighted thread, is held by a wooden cork (W_1) and is placed in the chamber (C) whose other end is closed by a wooden cork (W_2). No receptacle for the developing solvent is necessary. After equilibration, the solvent is placed in the adapter and closed with a cork. The solvent immediately commences to descend and develop the "papyrogram". If flooding is desired, the "development" is permitted to continue; otherwise the thread is air dried and bioautographed.

It will be seen that the method has been successfully employed for the partitioning of the various penicillins in a fermented beer and in quantities which range between $0{,}2 - 0{\cdot}05$ units. This ultra micro method is capable of being employed not only for an assay of other antibiotics but also for vitamins and other active principles whose presence can be detected by some type of bioautographic technique involving either an inhibition or growth of a suitable test organism. This method is now being further developed in our laboratories.

FIG. 2

Penicillium notatum grown on the Basal medium Supplemented with Enzyme-Free Moldy Bran Extract (1·0% solids). Papyrograms were developed on the thread. Activity tested by Bio-autographic technique using S. aureus as test organism. Shaded areas represent clearance zones.

Our grateful thanks are due to Prof. M. S. Thacker for his kind interest and encouragement.

Section of Ferment. Tech., Indian Inst. of Science, Bangalore,
June 10, 1951.

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M. SREENIVASAYA.

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BIGUANIDO DERIVATIVES OF DIARYL SULFONES AND SULFIDES

THE derivatives of *p-p'*-diaminodiphenyl sulfide and sulphone, 4-nitro-4'-aminodiphenyl sulphide and sulphone are well known for their antibacterial properties.[1-3] Diaminodiphenyl sulphone and its derivatives are widely used in the treatment of leprosy.[4] The biguanido derivatives of these amines have been prepared with a view to studying their pharmacological properties. These compounds were obtained by refluxing the amine hydrochlorides with proper cyanoguanidines in a suitable medium (alcohol, pyridine, etc.), and purified through crystallization from water or dilute alcohol. Some of these compounds have shown very encouraging antitubercular properties in *in vitro* tests.

The melting points of these compounds are recorded below.

R	$(R-X-C_6H_4)_2S$	$(R-X-C_6H_4)_2SO_2$	$R-X-C_6H_4SC_6H_4NO_2$	$R-X-C_6H_4SO_2-C_6H_4NO_2$
C_6H_5-	176°	240°	228°	170°
p-$Cl\cdot C_6H_4-$	172°	192°	207-08°	168°
p-$Br\cdot C_6H_4-$	166°	189°	178°	158°
p-$I\cdot C_6H_4-$	..	177°	..	..
p-$CH_3\cdot C_6H_4-$	170°	175°	199-200°	194°
p-$CH_3O\cdot C_6H_4-$	..	268°	..	..

$$X=-NH-\underset{\underset{NH}{\|}}{C}-NH-\underset{\underset{NH}{\|}}{C}-NH-$$

Attempts to make the bis-cyanamide of *p-p'*-diaminodiphenyl sulphone as an intermediate in the preparation of guanides as well as biguanides have been unsuccessful. Reaction with cyanogen bromide usually gave a resinous product instead of the expected cyanamide. Attempts to make the cyanamide via. thiourea also resulted in failure.

Organic Chem. Labs., B. N. JAYASIMHA.
Indian Inst. of Science, S. C. BHATTACHARYYA.
Bangalore, P. C. GUHA.
May 14, 1951.

1. Raiziss, *et. al.*, *J.A.C.S.*, 1939, **61**, 2763. 2 Feldman and Hinshaw, *Am. J. Clin. Path*, 1943, **13**, 144-7. 3. Smith, *et.al.*, *Am. Rev. Tuberc.*, 1943, **48**, 32-9. 4. *Lancet*, 1950, **1**, 145.

A SIMPLE DEVICE FOR SPRAYING MOULD SPORES FOR SURFACE CULTURES

IN the arrangement shown above a 50 ml. distilling flask serves as a useful spray-gun. 'A', a 25 ml. pipette, the bulb and 4 cm. length of each side of the bulb being packed well with cotton wool, is fitted to the neck of the distilling flask 'D'. A and D are sterilised in an air oven. The spores are mixed with sterile charcoal powder and transferred aseptically to the distilling flask. Air at about ¼ atmos. is blown in through 'A', when the mixture of the charcoal powder and spores gush out through the drawn-out side tube of the flask 'D' and could be sprayed as desired.

The cotton wool packing in 'A' serves as an air filter. The charcoal powder serves as support for the spores and provides a large surface.

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Indore,
April 2, 1951.

DETECTION OF GROUNDNUT OIL IN MUSTARD OIL

FOR the detection of groundnut oil in mustard oil the Bellier's test as modified by Evers,[1] depending on the clouding temperature of an acidified alcoholic saponified solution of the oil, is adaptable for routine work. However, this test, when applied in its entirety, fails to give concordant results with mustard and groundnut oils. It has been found that if the test is further modified in the following manner, results are reproducible:

(*a*) Using diluted acetic acid in place of Evers' hydrochloric acid (Sp. Gr. 1·16).

(*b*) Adding a definite extra amount of the acid after exactly neutralising the saponified oil to keep the acidity of the solution uniform.

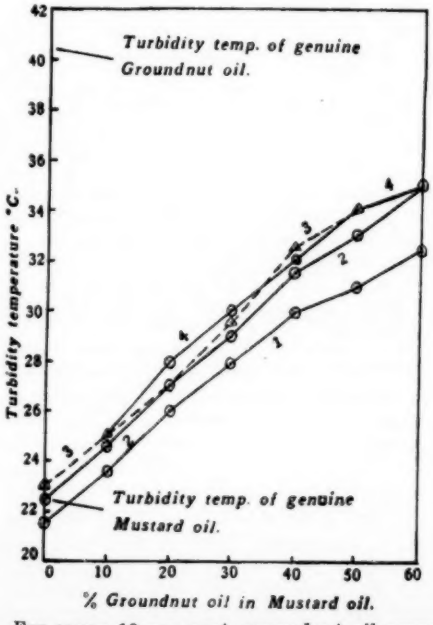
Test.—One ml. of the oil is saponified completely with 5 ml. of 1·5 N-alcoholic potash by heating over a small flame. Two drops of phenolphthalein indicator are added and the solution is carefully neutralised with 1 : 1 acetic

acid using a 1-ml. pipette graduated to hundredth. When the pink colour is just discharged, a further 0·2 ml. of the acid, measured accurately, is added. The solution is then mixed with 25 ml. of 70 per cent. alcohol, temperature raised to 50° C., and slowly cooled with constant shaking in a water bath maintained at 15° C. When the first sign of cloudiness appears the temperature is noted. This is the turbidity temperature.

By the above test, the turbidity temperatures of some common vegetable oils are found to be: groundnut oil: 40 to 41° C.; mustard oil: 21 to 23·5° C.; cocoanut oil: 18° C.; linseed oil: 21·5° C.; nigerseed oil (very old sample): 27°C.; sesame oil: 20° C. For mustard oil adulterated with groundnut oil, the turbidity temperature goes over 24° C. depending on the extent of adulteration. Also, presence of the latter will increase the saponification value and lower both the iodine value and the refractive index of mustard oil.

Further, the turbidity temperature of mustard oil increases almost proportionately with the increasing amount of groundnut oil present. The following figure makes this clear:

Rise in the turbidity temperature of mustard oil with gradual addition of groundnut oil.



For every 10 per cent. groundnut oil present, the turbidity temperature of mustard oil is raised by about 2° C.; thus, it is possible to estimate the amount of groundnut oil present provided a second adulterant is absent. It has been observed that in some cases even an addition of 20 per cent. groundnut oil does not raise the saponification value sufficiently high for the sample to be declared adulterated, but the turbidity temperature is, thereby making it possible to detect the adulteration.

It may, therefore, be presumed that for mustard oil a turbidity temperature of over 24° C. associated with a high saponification value, a low iodine number and a low refractive index gives sufficient evidence of the presence of groundnut oil.

The detailed work will be published elsewhere.

Public Health Laboratory, S. N. Mitra.
Govt. of West Bengal,
March 27, 1951.

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TUBERCULOSTATIC PROPERTIES OF SOME ANTIMALARIAL COMPOUNDS

When our studies of the antibacterial action[1] of the quinoline-substituted guanides (synthesised as possible antimalarials) were extended to include *Myco. tuberculosis*, it was observed that a number of these compounds showed tuberculostatic properties.[2] Administration of quinine in incipient cases of tuberculosis has also been known to give temporary clinical remissions.[3] Hence the following study was undertaken to elucidate whether this effect is due to a definite bacteriostatic action of the drugs on *Myco. tuberculosis* or merely a physiological, non-specific antipyretic action. Quinine and some of the other widely used antimalarials were subjected for their tuberculostatic property and *para*-aminosalicylic acid, a well-known anti-tubercular compound was included for a comparative study.

The simple synthetic medium as defined by Youmans[4] was chosen for the *in vitro* test. The H_{37} Rv strain of *Myco. tuberculosis* var. *honimis* obtained from the National Collection of Type Cultures, England, was the test organism.

Table I summarises the tuberculostatic action of the antimalarials at the end of 2 weeks.

A study of the above table indicates that up to 14 days, all the compounds except paludrine show complete inhibitory activity at 10 γ/c.c. level while a faint growth is visible with paludrine at this concentration.

TABLE I

Tuberculostatic properties of some antimalarial compounds (2 weeks incubation)

No.	Compound	Proprietary name	Drug concentration μg./c.c.					
			1000	100	10	5	1	0
1	6-Methoxy-α-(5-vinyl-2-quinuclidyl)-4-quinoline methanol (di-hydrochloride)	Quinine dihydrochloride	–	–	–	1+	1+	2+
2	N_1-*p*-chlorophenyl N_5-isopropyl diguanide	Paludrine	–	–	±	1+	2+	2+
3	7-Chloro-4-(4-diethyl-amino-1-methylamino)-quinoline (diphosphate) [*a*]	Chloroquine	–	–	–	1+	1+	2+
4	4 (3′-diethylamino-methyl-4-hydroxyanalino)-7-chloroquinoline [*a*]	Camaquin	–	–	–	1+	1+	2+
5	*Para*-amino-salicylic acid [*b*]	Paramisan	–	–	–	– –	–	2+

– Complete inhibition; ± faint growth; 1+ and 2+ various grades of growth; [*a*] Compounds kindly supplied by Dr. R. K. Anderson of Rockefeller Foundation, Bangalore; [*b*] Generous supply of Herts Pharmaceuticals, England.

Observation of the amount of growth was continued at weekly intervals and Table II shows the degree of inhibition at the end of 6 weeks.

TABLE II

Tuberculostatic action of antimalarial compounds (6 weeks incubation)

Compound	Absolute concentration μg./c.c.	Critical concentration μg./c.c.
Quinine dihydrochloride	100	10
Paludrine ..	100	10
Chloroquin ..	1000	10
Camaquin ..	1000	10
P.A.S. ..	5	1

Absolute concentration was taken to be the lowest concentration giving complete inhibition, while critical concentration was considered to be the lowest concentration μg/c.c. giving more than 50 per cent. inhibition. Table II shows that even at the end of 6 weeks, all the compounds still maintain more than 50 per cent. inhibitory activity at 10 μg/c.c.; complete inhibition is exhibited by quinine and paludrine at 100 μg/c.c.; by chloroquin and camaquin at 1,000 μg/c.c.; while P.A.S. suppresses growth at 5 μg/c.c.

The inhibitory action of all these antimalarials was observed to be entirely lost at the end of 12 weeks when the growths in the control as well as in the media containing the drugs were found to be almost equal; P.A.S. still maintained its suppressive activity.

In a similar *in vitro* experiment, Martin[5] has demonstrated that Mepacrine, another antimalarial, inhibits the growth of tubercle bacilli in a 1/1000 dilution. Hoggarth and Martin[6] have also observed that anilino pyrimidine, a chemical type from which paludrine was subsequently evolved possesses *in vivo* activity against tubercular infection of mice though of a slight degree.

We thus find that all the antimalarial compounds tested exhibit definite *in vitro* tuberculostatic property and one of them has been proved to possess slight *in vivo* activity. It is suggested that the slight clinical improvement noticed after administration of antimalarials to incipient cases of tuberculosis might be due to their tuberculostatic action.

Our thanks are due to Dr. K. P. Menon for the helpful suggestions during the course of the experiment.

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May 2, 1951.

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INTER-IONIC RELATIONSHIPS IN PLANTS AND THEIR SEEDS

It has been shown by Subbiah (1946) and Desai and Subbiah (1951) that the ratio of cations to nitrogen (as nitrate ion) is approximately constant for each species of plants and this ratio appeared to vary with the pH of the sap for different species. Working on similar lines, Bear (1950) showed that the overall cation-anion relationship in the whole plant can be expressed by the following equation at any given pH value:

$$\frac{K + Ca + Mg + Na}{N + P + S + Cl + Si} = \text{Constant.}$$

Bear (*loc. cit.*) explained this from the electrostatic balance of ions between the inside of the plant and the nutrient substrate. It follows from this that in seeds which are the starting point in the plant growth, the cation-anion ratio should also be constant. To examine this, the data comprising the best available in literature on the composition of different seeds is presented in the following table. In determining the equivalent weight of nitrogen, phosphorus and sulphur, they were calculated as NO_3^-, $H_2PO_4^-$ and $SO_4^=$ which are the most commonly absorbed forms. Chloride and silicate are not included here, as they usually occur in negligible proportion.

Considering the diverseness of the sources and the varying methods of analysis employed, the ratio of cations to anions in all the seeds is practically constant. Further work having a bearing on the above will be reported separately in detail.

The author wishes to thank Dr. S. P. Raychaudhuri, Dr. S. V. Desai and Mr. M. A. Idnani for their interest and encouragement in the preparation of this note.

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March 15, 1951.

TABLE I

Cation and anion contents in m.e. per 100 gm. of seed

Seeds	Individual cation content				Individual anion			Total contents of		Cation/anion ratio
	K^+	Ca^{++}	Mg^{++}	Na^+	NO_3^-	$H_2PO_4^-$	$SO_4^=$	Cations	Anions	
CEREALS										
Wheat (Forbes, 1913)* ..	13	3	11	1	118	17	12	28	147	0·19
Wheat (Cooper, 1948) ..	10	2	12	5	123	14	10	29	147	0·20
Corn (Forbes, 1913) ..	9	1	9	2	99	8	10	21	117	0·18
Corn (Cooper, 1948) ..	14	1	9	†	124	12	5	24	141	0·17
Oats (Forbes, 1913) ..	11	4	10	7	121	13	12	32	146	0·22
LEGUMES										
Soyabean (Forbes, 1913) ..	49	11	18	15	450	19	13	93	482	0·19
Navybean (Forbes, 1913) ..	29	10	15	3	254	12	12	57	278	0·20
Cowpeas (Forbes, 1913) ..	36	5	17	7	253	15	16	65	284	0·22
MISCELLANEOUS CROPS										
Mustard (Piesse, *et al.*, 1880) ·	21	21	23	†	319	24	9	65	352	0·19
Cotton (Cooper, 1948) ..	29	4	30	1	288	22	35	64	345	0·19
Tobacco (Paris, 1920) ..	23	13	28	4	250	12	†	68	262	0·25‡

* Refers to the source. † Less than 0·5 m.e. per 100 gm. of seed. ‡ Chloride may not be negligible in this case.

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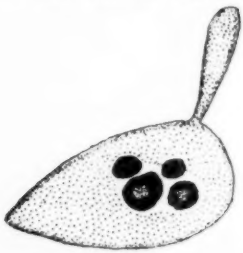
CRITICAL EVIDENCE FOR MITOSIS IN YEASTS

A new yeast mutant having an unequal pair of chromosomes was isolated in this laboratory in 1945.[1] This top yeast is relatively autotrophic,[2] has lost its power to ferment sugars,[3] and excretes considerable amounts of ribo-

flavin.[4] Owing to the above characteristics, the strain has been under observation for the past six years.[5]

Critical evidence for the identification of chromosomes is a demonstration of an anaphase in Feulgen preparations. When there is only a single pair of chromosomes having an identical shape *it is easy to demonstrate that each splits into two daughter halves but difficult to prove that only one daughter chromosome from each member of the original pair passes on to the bud.* The inequality of the chromosome pair in the top yeast makes it ideally suited for a demonstration that each of the chromosomes divides into a pair of chromatids and that the bud and the mother cell get always an unequal pair.

The photomicrograph is of a field from a smear fixed for 20 minutes in osmic vapour, hydrolysed for 6 minutes and stained with Feulgen's leuco-basic-fuchsin. At P is a cell at prophase. The nucleus appears as a clear



unstained area in the centre of which is a chromatin mass. The inequality of the chromosomes is seen in the cell at metaphase (M). The anaphase is characteristic (A, Photo; Fig.).

P. Prophase; M. Metaphase; A. Anaphase; T. Telophase. The length of the cell showing an anaphase is 4·8 μ.

The daughter chromosomes form two unequal pairs. The bud of the above cell appears to have reached a considerable size (Fig.). One pair of the daughter chromosomes would pass on to the bud (T, Photo) and thus the chromosome complement shows a fixity as regards their size. For the past six years (*cf.* illustrations of Subramaniam and Ranganathan[1]) the strain has retained its original chromosome constitution. It is this appearance of fixity and stability of the chromosomes that has been considered to be marvellous.[6] "Indeed it was this picture of precision and unity in the mitotic process which led Roux and Weismann to the conception of the chromosome theory of inheritance" (p. 634). The demonstration of an anaphase in Feulgen preparations should disprove Lindegren and Rafalko's[7] claim that these may be centrioles and that of Winge and Roberts[8] that the chromosomes are too small to be counted.

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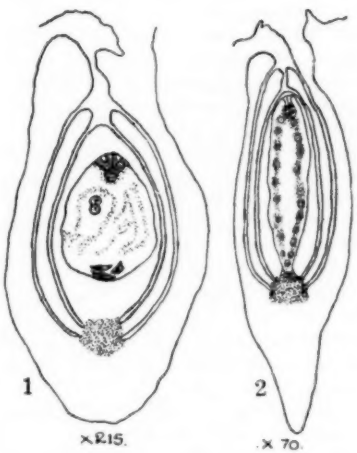
1. Subramaniam, M. K., and Ranganathan, B., *Nature* 1946, **157**, 49. 2. Prema Bai, M., *Curr. Sci.*, 1947, **16**, 316-17. 3. Mitra, K. K., *Proc. Ind. Sci. Cong., Poona*, 1950. 4. —, *J. Sci. and Ind. Res.*, 1949, **8B**, 236. 5. Ranganathan, B. and Subramaniam, M. K., *Ibid.*, 1950, **9B**, 4-11. 6. McClung, C. E., In *General Cytology*. Ed. E. V. Cowdry, 1925, 634. 7. Lindegren, C. C. and Rafalko, M. M., *Expl Cell. Res.*, 1950, **1**, 169-87. 8. Winge, O., and Roberts, C., C. R. Lab. *Carlsberg, Ser. Physiol.*, 1950, **25**, 36-80.

A NOTE ON THE EMBRYOLOGY OF *DIOSCOREA OPPOSITIFOLIA* L.

Dioscorea oppositifolia L. is a member of the Dioscoreaceæ, and the literature on the embryology of this family has been reviewed by Schnarf.[2] The young anther is made up of three wall layers external to the tapetum. The tapetal cells are binucleate and are of the glandular type. The endothecium develops fibrillar thickenings. Separation of microspores takes place by cell plate formation and the microscpores are arranged in an isobilateral manner. Occasionally they exhibit a tetrahedral arrangement. The pollen grain at the time of shedding is oval in outline with a pro-

minent tube nucleus and a lenticular generative cell.

The ovary is inferior, trilocular, with a single anatropous crassinucellate bitegmic ovule in each locule attached on the axile placenta. At the chalazal region of the ovule a hypostase-like tissue is present consisting of compactly arranged cells with dense cell contents and prominent nuclei. The archesporium is differentiated in the young nucellar primordium. It divides transversely producing the primary parietal cell and the megaspore mother cell. Megasporogenesis proceeds normally and the development of the embryo-sac follows the Polygonum type.[1] The mature embryo sac is oval in outline (Fig. 1). The synergids are



hooked and the egg is pearshaped. As in *Dioscorea villosa*,[3] one of the synergids persist during the early stages of embryo development. The polars fuse in the centre of the embryo sac. The antipodals are organised as cells and degenerate soon after fertilisation.

After fertilisation the antipodal end of the embryo sac elongates and finally reaches the hypostase-like tissue (Fig. 2). Into this portion the free endosperm nuclei migrate. At a later stage the free nuclear endosperm becomes cellular.

The first division of the fertilised egg is usually transverse, rarely oblique, resulting in a two-celled embryo. In *D. villosa* the fertilised egg divides usually in an oblique manner and sometimes either vertically or transversely. A vertical wall is then laid down in both these cells. Succeeding divisions are irregular and by further development the adult embryo is produced. The mature embryo is elongated with a terminal cotyledon and a lateral stem tip.

The seed is winged, with a four-layered testa and a tegmen made up of two layers. The cells of the innermost layer of the testa develop characteristic lignified thickenings on their basal and tangential walls.

My sincere thanks are due to Prof. L. N. Rao and Dr. K. Subramanyam for helpful suggestions.

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May 9, 1951.

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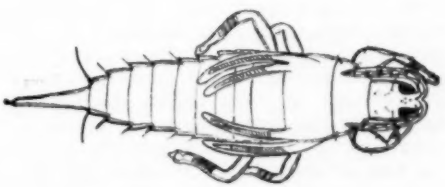
FEMALE PUPA OF *DINOTHRIPS SUMATRENSIS* BAGNALL

DESCRIPTION : General colour of the body, brownish yellow; eyes dark. Antennæ eight jointed, setaceous, straight in front of head and bent caudad at the second joint. Joints 3-6 of the same length, narrow at base and broad towards the apex. Sense cones prominent in segments 3-6.

Head as long as broad and round above the eyes with cheeks almost parallel. Eyes black and occupying more than one-thirds the length of the head. Ocelli fairly clear arranged in a triangle. Interocular space larger than the width of an eye. Postocular spine very prominent and more than half the length of the head. Two small spines below and opposite to the inner margin of each eye. Below the latter, in a level with the postocular spine, are two smaller spines. Marginal spines absent. Mouth cone narrow and bluntly pointed.



Female Pupa of Dinothrips Sumatrensis Bagnall.

Prothorax almost as long as head and slightly shorter than the pterothorax. Prothoracic spines long and pointed, anterolateral, mid-

lateral and posterolateral ones being present. The midlateral spine is the longest of the three. Pterothorax as long as wide and longer than head and thorax put together. Spines lacking.

Legs well differentiated, the forelegs being prominent. Forefemora stout, with two spines one on each border. Tibia curved at base and fringed at the margin. Tarsus with a prominent curved tooth. Mid and hind legs equal, with tibia distinctly fringed. Prominent spines lacking.

Abdomen longer than the head and the thorax put together being broadest at base and gradually narrowing to the posterior extremity. A pair of small lateral spines present one on each side, on each segment, those on segments 3-7 being distinct. Tube long with a few small hairs at the extremity. Wing pads equal, reaching upto the third abdominal segment.

MEASUREMENTS: Total length: 4·3 mm.; Length of Antennæ (in the bent position) ·812 mm.; Width of eye 7 μ; Interocular space 10μ; Postocular spine 15 μ; Length of head ·391 mm.; Width across eyes ·391 mm.; Length of prothorax ·406 mm.; Width of prothorax ·768 mm.; Length of pterothorax ·914 mm.; Width of pterothorax ·87 mm.; Length of abdomen 2·61 mm.; Length of tube ·768 mm.; Length of wing pads 1·08 mm.

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EXTENSION OF GEOGRAPHIC RANGE OF *PSILORHYNCHUS BALITORA* (HAMILTON)

Psilorhynchus balitora is recorded from Uttar Pradesh for the first time and is an extension in the known range of the species as defined earlier by Day[1] and Hora.[2] On June 15, 1949, two specimens were found among a collection made from Gomti River, Lucknow, U.P., in association with *Nemachilus zonatus*. At first their detection had escaped notice but the absence of barbels made their separation from the collection easy at the time of detailed examination and a search was started for more specimens. On February 27, 1950, eleven specimens were again captured from the same locality. Six were kept in an aquarium to study their feeding and spawning habits but they did not take well to aquarium conditions and all the specimens died within two days. On June 24, 1950, further 75 specimens were collected at another place, Pipraghat, Lucknow. The specimens are preserved in the Department of Fisheries collection of fishes. Dr. Hora during a discussion in the meetings of the Zoological Section of the Indian Science Congress held at Bangalore reported that (just when he was leaving for Bangalore) he had received a very young specimen of *Psilorhynchus balitora* collected from Delhi. If more specimens are captured from this locality, a further record of westward extension of the range of *Psilorhynchus balitora* will be established.

Psilorhynchus balitora is generally found on sandy bottoms in clear rapid running streams and at the place of capture of the specimens under report water flows with force as a result of setting a weir although no boulders or rocks exist at these places. The fish were caught by an ordinary scoop net. The standard size of mature individuals varied from 1½" to 2". Our biggest specimen was 2". It is likely *Psilorhynchus balitora* has established at the places of capture as smaller specimens of 1" were captured. The specimens were invariably found in association with *Nemachilus zonatus*. The collected specimens resemble closely to the published figure by Day (*op. cit.*, Fig. No. 86) except slight variations in colouration. The general colour of the fish is palish white with 7 or 8 faint black blotches on the mid-dorsal line and about the same number of irregular smaller blotches along the lateral line. The caudal fin does not have 3 transverse bars as described by Day but has only two black streaks one corresponding to each lobe of the fin. The head is somewhat depressed and mouth is markedly inferior. D 10; A 7 (2/5); V 9 (2/7); P 17(5-7/10-12); head 5-5½ of total length; scales above lateral line 3. An examination of gut showed sand in large quantities and pieces of algæ which were identified as *Ulothrix*, *Hormidium*, *Nitzschia*, and *Gomphonema*. A detailed paper dealing with the ecology of this interesting fish will be contributed later on.

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January 5, 1951.

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1. Day, *Fauna of British India, Fishes*, 1889, **1**, 244.
2. Hora, *Rec. Ind. Mus.*, 1925, **27**, 457.

DYNAMICS OF EYE-STRIPE COMPOSITION, BIOMETRICAL RATIOS AND CERTAIN OTHER CHARACTERS DURING PHASE TRANSFORMATION IN THE DESERT LOCUST

THE dynamics of phase-transformation in the first two years of a new or 9th recorded swarming cycle of desert locust, *Schistocerca gregaria*

(Forsk.), which commenced in 1949, have been studied with respect to variation in the eye-stripe composition, sex-ratios, and biometrical ratios of the size of the body-parts, etc. The populations studied are: (*i*) the incipiently swarming first year's population (about 20,000 per sq. mile) at Kakko in Bikaner District in the Rajputana Desert, in July 1949; and (*ii*) the second year's swarming population at Ajmer, Rajputana, in June 1950. These two populations are compared to the typically *gregaria* and typically *solitaria* populations studied earlier by Roonwal[4] (1949) and Roonwal and Nag[5] (1950). The more important results are briefly given below.

The first year's or 1949 Kakko population was intermediate between the phases *solitaria* and *gregaria*, but closer to the former. The eye-stripe composition was 94 per cent. 6-eye-striped, 5·6 per cent. 7-striped and with one example of a 5-striped individual. This contrasts with 100 per cent. 6-eye-striped individuals in typical swarms, as shown by Roonwal[2] (1945). For particulars regarding variation in the eye-stripes, see Roonwal[1,3] (1936, 1947). The ♂ : ♀ sex-ratio was not significantly different from 50 : 50, which is a phase *gregaria* characteristic.

The second year's or 1950 Ajmer population, though in some respects intermediate, was very close to typical *gregaria*.

The body-characters studied were the following: Length of elytron (E), width of elytron (W), length of hind-femur (F), maximum width of head in genal region (C), length of pronotum at the keel (P), and the ratios E/F, F/C, P/C and E/W. It has been found that of all these characters, the head-width (C) is the most phase-sensitive (*vide* also *infra*), and the same applies to the ratios associated with head-width, namely, E/C, F/C and P/C. Dirsh[6] has also recently reported on the sensitiveness of the ratio F/C. However, while he has rightly taken sex variation into consideration, he does not appear to have taken into account the very real eye-stripe variations, so that his conclusions are possibly statistically vitiated to that extent.

The use of discriminant functions of more than one biometric character as regards the size of the body-parts was critically studied from the statistical point of view. Taking individual characters, C was found to be the most discriminant of all the four characters, namely, E, F, C and P, for both males and females. If more than one character is used for discriminating between the phases, C and P were found to be the best set of characters for males, and C, F and P the best set of characters for females. The ratios E/C, F/C and P/C discriminate better than E/F probably due to the fact that C is the most discriminant single character.

In 1945, Roonwal[2] tentatively put forward three hypotheses for the prediction of swarming of the desert locust. These hypotheses have now been re-examined and their soundness has been statistically established.

Full results of this investigation will be published elsewhere.

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March 17, 1951.

1. Roonwal, M. L., *Curr. Sci.*, Bangalore, 1936, **5**, 24. 2. —, *Bull. ent. Res.*, London, 1945, **35**, 391-93. 3. —, *Proc. R. Soc. Lond.* London, 1947, **134B**, 245-72, 3 pls. 4. —, *Rec. Indian Mus.*, Calcutta, 1949, **45**, 149-65. 5. — and Nag, M. K., *Ibid.*, 1950, **47**, 13-23; also in *Proc. 37th Indian Sci. Congr. (Poona)*, 1950, Pt. 3, *Abstracts*, p. 249. 6. Dirsh, V. M., *Nature*, London, 1951, **167**, 281.

FOOD PLANTS OF THE DESERT LOCUST

Husain and Mathur (1946) gave three lists of plants, not eaten at all, eaten with great reluctance and eaten readily by the desert locust, *Schistocerca gregaria* Forsk. The first-mentioned list includes onion (*Allium cepa*) and *neem* (*Melia azadirachta*) plants and observations of two other workers, Roonwal and Bhatia, respectively, are quoted as indicating that *neem* leaves are 'absolutely avoided' by the desert locust. This has also been the general belief of entomologists, myself included. In July 1950, however, a swarm of desert locusts settled on some *neem* and other trees in Kanpur city and the locusts nibbled at the *neem* leaves, though the entire leaves were not eaten. A similar observation was made earlier in June in a village about 50 miles south of Kanpur city. During February 1951, reports were received of damage by locusts to a number of crops, which included onion, in Almora district. Soon after these reports were personally verified by an officer of the Plant Protection Service, U.P., when onion crops were found to have had their leaves eaten away by the locusts.

It would appear, therefore, that the adults of the desert locust are not averse to feeding

either on the leaves of *neem* or on those of onion, though it is possible that they may not do so with avidity. It is noteworthy, however, that, wherever the *neem* and onion leaves were eaten, there were also various other plants present to serve as food for the locusts.

Section of the Entomologist to Government, Uttar Pradesh, Kanpur, *March* 29, 1951. K. B. LAL.

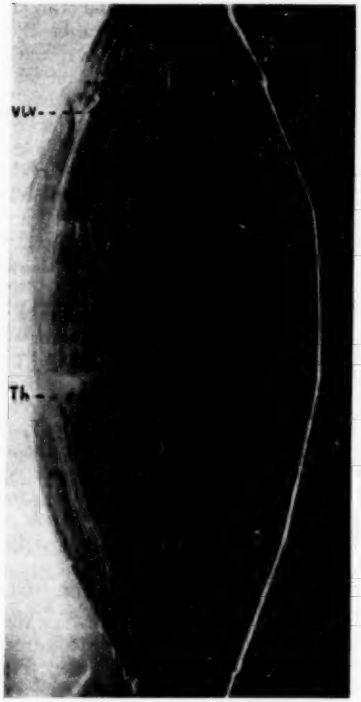
1 Husain, M. Afzal and Mathur, C. B., *Indian J. Ent.*, 1946, **8**, (2), 141.

A NEW ACCESSORY STRUCTURE TO THE OVIPOSITOR TO AID OVIPOSITION AND BORING IN A PARASITIC SCELIONID (*HYMENOPTERA PROCTOTRYPOIDEA*)

WHILE studying the morphology of the ovipositor of a Scelionid egg-parasite—*Scelio oviphagæ* sp. nov., parasitic on *Hieroglyphus nigroreplet-us* Bol. eggs collected from Ajmer, a peculiar structure, so far undescribed, was noticed in association with the ovipositor, the structure and probable function of which are as follows: The adult female, in certain members of this family, bores through the hard earthen covering of the egg-pods of various Acridiids.

In continuation of the inner valve of the ovipositor an ancillary supporting double-walled structure (Fig. 1) was traceable right up to the 1st (morphologically III) segment of the abdomen. This composite tube in a slide-mounting is indistinguishably continuous with the inner plate of the ovipositor beyond the 7th abdominal segment anteriorly. In the 2nd (morphologically IV) segment, somewhat anteriorly, a pair of thin valvular structures was traced along this tube while near about the IV segment (morphologically VI), the tube appeared to be slightly wider and pouted with crenulations (*th.*) or fine denticles on each side.

As to the function of this organ, it is likely that this is a special structure acting either like a pneumatic drill or at least as a strengthening or supporting structure to the ovipositor as a whole. The paired valves (*vlv.*) of the inner tube allowing, in case of high pressure, the excess air or cœlomic fluid to pass through the thin channel to the small anteriormost chamber in continuation with the tube. The crenulations on the tube near about the middle (anterior edge of the 4th segment) as also the slight widening respectively prevents friction, strengthens and provides flexibility to the long tube during the process of boring.



No segmentation is, however, visible on the tube and it appears to be a continuous one. Ontogenetically, the tube might have been formed by the segmental processes of the abdominal sternites which have got detached entirely from the original sternites during the post-embryonic developments thus forming a tubular structure. As to their chitinous origin there appears to be no doubt, since the entire abdomen was well macerated in cold caustic for about three days.

Division of Entomology, Indian Agricultural Research Institute, New Delhi, *May* 2, 1951. S. MUKERJI.

1. Snodgrass, R. E., *The Principles of Insect Morphology*, 1935, pp. 616-20.

REVIEWS

Molecular Spectra and Molecular Structure—I. Spectra of Diatomic Molecules. By G. Herzberg. Second Edition. (Van Nostrand), 1950. Pp. xv + 658. Price $9·75.

The first edition of this book has been out of print for some time and the arrival of the new edition will be welcomed by students and workers on molecular spectra. Although the book has been completely revised and brought up to date, its general plan has remained substantially unchanged. It starts with a brief résumé of atomic structure and the observed facts in molecular spectra. Then follow a chapter on the interpretation of the infra-red and Raman spectra based on the rotation and vibration of the molecules and two chapters on electronic states and electric transitions. Applications to other fields of physics, chemistry and astrophysics are contained in the last chapter. Other topics, such as electron configuration, term manifolds, valence, continuous spectra, predissociation, etc., are also discussed in good detail.

While, of course, most of the material is not original, Prof. Herzberg has done a great service by compiling all the diverse information available in a single volume, in which they are presented in a fine analytical manner. Eighty pages at the end of the book are devoted to a table of "Vibrational and Rotational Constants for the Electronic States of all Known Diatomic Molecules", the only table of its kind available at present. A bibliography of 1574 entries gives complete reference to published work on the subject up to 1949. It can be confidently stated that the book will be found indispensable by every worker in molecular spectra.

Scientific Russian: A Text-Book for Classes and Self-Study. By James W. Perry. (Interscience Publishers, Inc., New York), 1950. Price $7·50.

The book serves a threefold purpose. It is a comprehensive text-book in the classroom, an excellent guide for self-study, and a highly informative work for reference which is furnished with an index (pp. 799-816) giving a complete list of all the grammatical items discussed in the previous lessons. The Russian-English and the English-Russian vocabularies list all the words found in the reading exercises. Hardly any aspect of Russian syntax and idiom with which the reader of Russian scientific literature must be acquainted, is missing.

From the very beginning, the book under review uses only the vocabulary which is essential for reading scientific texts, leaving aside the phraseology of the everyday language. The book is divided into forty lessons which include reading- and translation-exercises. But more space has been allotted to the reading-exercises which cover two and a half pages in some of the advanced lessons and form coherent discussions of topics such as "The States of Matter", "Atomic Energy", "Sources of Light", "Vitamins", "Radioactivity", "Sodium", "Radar", etc. Throughout the book, the Russian words are printed with their accent, which is a great help for the beginner to pronounce correctly, as some of the Russian vowels have quite different sound values according to whether a syllable is stressed or not.

The author has the gift of discussing all points in a simple and lucid language, avoiding the jargon of the philologist. The get-up of the book is most attractive. The arrangement of the print adds considerably to the clearness of the presentation of the subject-matter. From the aesthetic point of view the book is highly inviting. The book should find a place in the library of all universities and institutes where Russian is taught, and especially where Russian scientific literature is studied.

W. GRAEFE.

Fats and Oils: Soyabean and Soyabean Products, Vol. I. Edited by Klare S. Markley (Interscience Publishers, Inc., New York), 1950. Pp. xvi + 540 and 128 Figs.

This book is in itself an instance of the popularity of soyabeans in America. Almost all the important aspects governing the agricultural production of soyabeans have been dealt with here in a thorough and clear manner. Also, valuable information concerning world production and trade aspects of soyabean is given, together with a detailed account of the chemical and physical composition and chemical characteristics of soyabean oil.

The comprehensive treatment on the proteins and other nitrogenous constituents of soyabean, with particular reference to the isolation of proteins, chemical and physical properties of

soyaproteins and partial and complete hydrolysis of the proteins would be found to be extremely useful by the research workers in this field of study. The chapter on 'Nutritive factors in soyabean products' gives a very clear and complete picture of this very important aspect. Most of the outstanding work carried out on this problem has been well discussed.

Handling and farm storage are also important aspects and these have been dealt with in detail. The biological processes in stored soyabeans are discussed from the standpoint of the conditions of storage as affecting germination and composition of the seed. A complete account of the various methods employed for the mechanical processing of soyabeans is given with sketches of the different machines employed. The reader thus gets a complete story of the soyabean straight from the growing to the final processing stage.

It may not perhaps be out of place to mention here the verdict pronounced by the Soyabean Sub-Committee of the Nutrition Advisory Committee that there was nothing in soyabean to demand any encouragement for the production of soyabean on a large scale. The experimental observations cited in this book on the other hand would indicate that soyabeans are rather outstanding nutritionally, among the legume seeds of the U.S.A.

The book has an excellent get-up and should find a place in every library.

S. S. D.

The Manufacture of Intermediates and Dyes. *An Introduction to Works Practice.* By G. H. Frank. (Constable & Co., Ltd., London), 1950. Price 15 *sh.*

The author has "long and wide experience in the manufacture of intermediates and dyes", and the book is written with the object of showing how these are made and why certain methods and materials are used in practice. The first aim has been partly fulfilled, but not the second. It is true, as the introduction states, that there is need for a modern treatment of the important subject of the manufacture of intermediates and dyes, but this book certainly does not meet it. The technology of dyes, like the technology of other chemical products, has to be based on sound chemistry and sound chemical engineering, and a series of recipes for works processes, assuming their authenticity, do not constitute a suitable text-book for students in colleges and universities. As a guide to knowledge of the latest methods actually employed in the dyestuff industry, a serious defect is the complete omission of the information on I.G. processes which are now available in numerous BIOS and FIAT reports, microfilms and documents. There is not even a reference to this vast literature.

The choice of intermediates and dyes and their classification are difficult to understand. Part II entitled "Benzene Series" includes sulphur dyes, and Part III "Naphthalene Series" includes azo dyes; these two classes of dyes are not restricted respectively to benzene and naphthalene intermediates. Diazotization and coupling are dealt with very inadequately, and this is also true of several groups of dyes, such as the anthraquinonoid vat dyes which are disposed off in five pages; azines, oxazines, thiazines (*e.g.*, Methylene Blue), diphenylmethanes, triphenylmethanes, thioindigoids and Indigosols are not even mentioned. Many obsolete names are used, and quite a few formulæ are incorrect. Thus Naphthol AS-G and Naphthol AS-RL are bracketed together, and assigned the structure "Diacetoacetic toluide of β-hydroxynaphthoic acid". An accurate list of Fast Bases could have been obtained from Saunders' "Aromatic Diazo-Compounds", to which incidentally no reference is made.

The second and third chapters dealing with materials used in the construction of plant and with hazards of the industry are useful; but on the whole this book is very disappointing and does poor justice to an important subject. The book is well printed and the diagrams, mainly supplied by Simon-Carves, Ltd., are excellent.

K. V.

Distillation (Technique of Organic Chemistry, Vol. IV). By A. and E. Rose, F. E. Williams, A. S. Glasebrook, C. S. Carlson, J. R. Bowman, R. S Tipson, J. E. Hecker and E. S. Perry. (Interscience Publishers, Ltd., London), 1951. Pp. xxvii + 668. Price $ 14·00.

This treatise on distillation is a welcome addition to the library of the chemist, physicist and the chemical engineer. Since the classical publications of Lewis, Young, Hausbrand, McCabe and Thiele, many investigators have added to our knowledge of the theory and technique of distillation and these recent contributions scattered in journals like *Ind. Eng. Chem.* and *Trans. Am. Inst. Chem. Engrs.* are brought together and presented in easy sequence in this volume.

The theory of batch distillation is discussed excellently by A. and E. Rose in Chapter I, dealing with vapour-liquid compositions, which contains a mathematical treatment of theoretical plates, performance in columns, effects of process variables and is illustrated with curves,

tables and references. Distillation of liquefied gases and low boiling hydrocarbons is described by the same authors in another chapter. Laboratory fractional distillation, apparatus and procedure employed are described in Chapter II. Extractive and azeotropic distillation to separate close-boiling components, entrainer—use, apparatus and industrial applications are treated by C. S. Carlson. Chapter V deals with distillation under moderate vacuum. The chapter by E. S. Perry and J. C. Hecker, discusses the technique employed in high vacuum distillation, such as 'cold finger stills', boiling point still, centrifugal, pot and falling film molecular stills. The vacuum system, free molecular flow, ejector and diffusion pumps, gases, cold traps and leak detectors are discussed in the second half of the chapter. In the last Chapter VII, sublimation or direct crystallisation from the gas phase, as being more efficient than distillation, is classified as vacuum, ordinary and entrainer sublimation. Vertical and horizontal sublimators, as well as fractional microsublimation, useful in analysis of drugs and in pharmacognosy are also discussed in this chapter.

The volume is amply illustrated and provides an up-to-date, comprehensive information to the student and research worker in the laboratory. For the next edition, it may be suggested to include an additional illustrative chapter on industrial distillation, equipment and technique employed in works practice, which would enhance the usefulness of this excellent publication.

Y. K. RAGHUNATHA RAO.

Plant Biochemistry. By James Bonner. (Academic Press, Inc., New York), 1950. Pp. xvii + 537. Price $6·80.

A significant outcome of recent advances achieved in several branches of biochemistry is knowledge concerning the biochemical kinship of all living things. The metabolic processes in microorganisms, plants, animals and man are all discernably related. This ubiquitous nature of the biochemistry of the living cell has given a new orientation to researches in plant metabolism. Bonner's book admirably sums up existing knowledge on various aspects of the subject. The metabolic pathways in plants that have been discussed here remind one of the important fact how numerous problems of plant biochemistry, hitherto fragmentarily understood, have been and could yet be approached by close application of the information and the techniques that have been developed by those working with other organisms. The treatise however is concerned not only with the intermediary metabolic processes which are well understood in other groups of organisms, but also with matters which peculiarly concern plants such as the metabolism of starch and of the cell wall, the formation of certain typical secondary products and the biochemistry of photosynthesis.

The book is divided into six sections. Part I deals with carbohydrates, their nature and their simple transformations into sugars and such complex but metabolically active forms as starch and other reserve polysaccharides. Part II is devoted to the cell wall which is largely made up of polysaccharides derived more or less directly from the simple sugars and to a demonstration that cell wall formation constitutes perhaps the largest single drain on the carbohydrate supply of the plant. Part III is concerned with the plant acids and with a lucid exposition of plant respiration as a whole. In Part IV is presented available information on the manner in which proteins and other nitrogenous constituents of the protoplasm are synthesised and otherwise metabolised. The general group of secondary products—lipids, isoprenoids, simple and polyterpenes and the anthocyanins and related compounds—are considered in Part V. The last section (Part VI) gives an outline of the biochemistry of hormonal growth regulation and of presently known facts concerning photosynthesis.

The discussions and interpretations of data are throughout authoritative and reflect the wide experience which Dr. Bonner has had in the field. Although the presentation is linear in sequence, it is also suggestive of the cyclical pattern of metabolic pathways. Thus, beginning with carbohydrates, the book passes on to respiration, proteins, various secondary products and finally, through photosynthesis, to carbohydrates again. One would have looked for some account of ion absorption and mineral nutrition of plants in a book of this kind as these have important biochemical implications.

There are sections for general reading at the end of each chapter together with carefully chosen specific references for the advanced worker. The indexing is good and there are few typographical errors. This monograph is at once both a text-book for the graduate student and a book of reference to the research worker.

A. SREENIVASAN.

SCIENCE NOTES AND NEWS

Raptakos Medical Research Fellowships

The Raptakos Medical Research Board will consider applications for the award of Fellowships for research work in recognized institutions on Medical and allied subjects. The awards normally consist of Rs. 3,000 per year for a Fellowship and Rs. 750 per year towards special equipment or chemicals.

The applications should be accompanied by six copies of a brief statement of the research project and the comments of the guide regarding the suitability of the project and the facilities existing at the Institution. Fellows appointed should have an M.B., B.S., or M.Sc. degree or its equivalent or not less than 2 years' experience in research work after B.Sc. The awards are made annually and may be renewed on the basis of satisfactory progress. Applications for Grants for the year commencing 1st January, 1952, should reach the Secretary, Raptakos Medical Research Board, C/o Raptakos, Brett & Co., Ltd., Dr. Annie Besant Road, Worli, Bombay-18, before 1st September, 1951.

Radioactive Standards

The Joint Commission on Standards, Constants and Units of Radioactivity, in its meeting of July 1950, held at Paris, have agreed to recommend the following definition of the Curie. The Curie is a unit of radioactivity defined as the quantity of any radioactive nuclide in which the number of disintegrations per second is $3{\cdot}700 \times 10^{10}$.

The following abbreviations have also been recommended: c. for curie; mc. for milli-curie; μc. for micro-curie; Kc. for kilo-curie.

Also, the Commission have agreed that the word 'barn' for 10^{-24} cm.^{2} now in common use as a unit of cross-section for nuclear processes be accepted as the standard unit.

New Ruling Engines for Gratings

Dr. Strong of the Office of Naval Research, U.S.A., has developed a new design of an engine for ruling gratings, in which the grating blank is made to reciprocate beneath a diamond which is supported and moved slowly by two parallel screws, unlike the usual Rowland type. "Fanned" lines are not produced by the new engine, which is designed for immunity to temperature, friction and wear. The present pilot model machine can rule 14,000 line gratings in sizes up to six inches in about 67 hours.

—(*Sky and Telescope*, 1951, *10*, p. 161)

Heart Surgery

At birth, the heart of a "blue baby" is not properly developed and the blood does not circulate fully through the lungs. The supply of oxygen is therefore restricted and the blood, instead of being a normal red, is overcharged with carbon and has a definite bluish tinge.

In 1945 Drs. Alfred Blalock and Helen B. Taussig, of the Johns Hopkins Hospital, Baltimore, U.S.A., developed a new surgical technique for dealing with the "blue baby", which is to-day in increasing use throughout the world.

W.H.O. is helping to extend the use of these modern methods by sending groups of specialists to demonstrate their technique to the practitioners of countries previously unable to put these advances to practice.

Medicinal Plants in India

A publication which is likely to be of considerable interest to the drug industry in India has been brought out by the Council of Scientific and Industrial Research. Entitled, *Distribution of British Pharmacopœial Drug Plants and Their Substitutes Growing in India*, the bulletin is a comprehensive compendium of the medicinal plants grown in the country together with the regions where they are found naturally. Priced at Rs. 1-4-0 per copy, it is available from the Publications Division of the Council at 20, Pusa Road, New Delhi.

ERRATUM

Vol. 20, No. 5, May 1951, page 131, in the paper, "Effect of Certain Hormones on Growth and Reproduction of some species of *Phytophthora*", *read* the following description of Plate I:

FIG. showing the inhibitory influence of 1-naphthyl acetic acid on the growth of *Phytophthora arecæ*. Ie—Basal medium + Yeast extract, Iev_1 — Basal medium + Yeast extract + 1/10 000 conc. of the hormone, and Ic—Basal medium only.

Secretary: M. Sreenivasaya, B.A., F.I.I.Sc., F.A.Sc. Editor: G. N. Ramachandran, M.A., Ph.D. D.Sc., F.A.Sc.
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